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Great Lakes Literacy Principles

Lakes Superior, Huron, Michigan, Ontario, and Erie together form North America's Great Lakes, a region that contains 20% of the world's fresh surface water and is home to roughly one quarter of the U.S. population (Figure 1). Supporting a $4 billion sport fishing industry, plus $16 billion annually in boating, 1.5 million U.S. jobs, and $62 billion in annual wages directly, the Great Lakes form the backbone of a regional economy that is vital to the United States as a whole (see http://www.miseagrant.umich.edu/downloads/economy/11-708-Great-Lakes-Jobs.pdf). Yet the grandeur and importance of this freshwater resource are little understood, not only by people in the rest of the country but also by many in the region itself.

To help address this lack of knowledge, the Centers for Ocean Sciences Education Excellence (COSEE) Great Lakes, supported by the U.S. National Science Foundation and the National Oceanic and Atmospheric Administration, developed literacy principles for the Great Lakes to serve as a guide for education of students and the public. These "Great Lakes Literacy Principles" represent an understanding of the Great Lakes' influences on society and society's influences on the Great Lakes.

Eight Key Facts to Guide Public Understanding

The Great Lakes literacy effort had its origins in Ocean Literacy (http://www.oceanliteracy.net), a movement by hundreds of scientists and educators who developed a concise framework for conveying the most important ocean science concepts that all students in grades K-12 should know.

With support from Ocean Literacy proponents in COSEE California, COSEE Great Lakes leaders examined the Ocean Literacy and fledgling Lake Erie Literacy Principles and Concepts (www.ohiodnr.com/LakeErieLiteracy/) and drafted a baseline set appropriate for the region. About 80 scientists and educators from around the Great Lakes region reviewed and edited the list through multiple drafts, and the Great Lakes Literacy Principles emerged.

The Great Lakes Literacy Principles are as follows:

1. The Great Lakes, bodies of fresh water with many features, are connected to each other and to the world ocean.
2. Natural forces formed the Great Lakes; the lakes continue to shape the features of their watershed.
3. The Great Lakes influence local and regional weather and climate.
4. Water makes Earth habitable; fresh water sustains life on land.
5. The Great Lakes support a broad diversity of life and ecosystems.
6. The Great Lakes and humans in their watersheds are inextricably interconnected.
7. Much remains to be learned about the Great Lakes.
8. The Great Lakes are socially, economically, and environmentally significant to the region, the nation, and the planet.

These principles are designed to be crisp and quotable. Numbering provides shorthand for comparison with similar principles of ocean literacy and for easy discussion among users.

Using the Literacy Principles: Lesson Plans, Textbooks, and Tests

To enable use of the Great Lakes Literacy Principles, Ohio Sea Grant hosts an Internet resource (http://greatlakesliteracy.net) for Great Lakes literacy subject matter, curricula, and other resources. At this site, fundamental concepts within each principle are defined, accompanied by relevant examples and a description of each principle's scope. Educators and scientists can contribute annotated links and other resources useful for Great Lakes literacy—site managers are particularly interested in information that compares the Great Lakes to equivalent characteristics of the ocean. The site currently links to lesson plans, teaching aids, science subject matter, and examples of content presentations, as well as organizations and agencies that deal with regional issues.

Educators, both formal and informal, of learners of all ages are the primary audience for Great Lakes Literacy Principles. Education about the lakes is currently not available through traditional school sources. Most textbooks used in the region for biological, Earth, and environmental sciences—such as Glencoe's *Earth Science: Geology, the Environment, and the Universe*, Prentice Hall's *Biology*, and Pearson/Prentice Hall's *Science Explorer: Environmental Science*—make no mention of the Great Lakes. When they are mentioned, as in Wiley's *Environment* and Pearson/Prentice Hall's *Science Explorer: Earth's Waters*, the Great Lakes receive scant attention—one page and two sentences, respectively, in those volumes. As textbooks move toward online publishing, there may be opportunities for regional editions based on state instructional standards, so it will be important to demonstrate how Great Lakes literacy fits those frameworks. Development of the Great Lakes Literacy Principles, which are currently aligned with National Science Education Standards (http://greatlakesliteracy.net/resources/alignment/), may be a crucial first step in meeting these future needs for regional emphasis.

To facilitate application in classrooms, there is also a need for the principles to

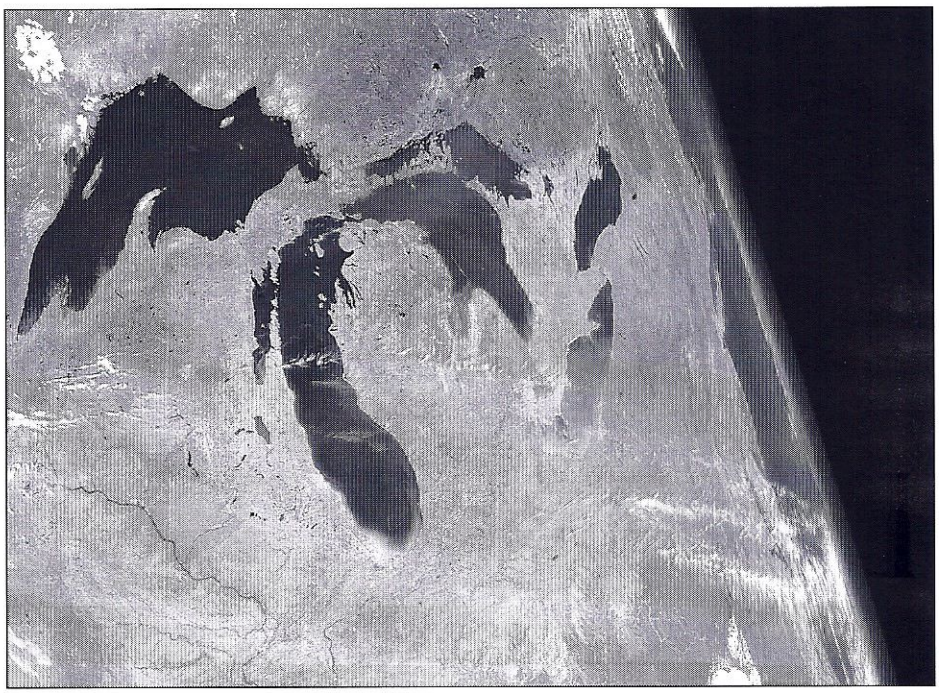

Fig. 1. The North American Great Lakes as seen from space in 1999 by the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) on board the SeaStar satellite. Image from the SeaWiFS Project, NASA Goddard Space Flight Center, and ORBIMAGE.

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appear in standardized tests. Only a few isolated questions on state tests in the region give evidence that lake science is part of the science curriculum at all. From science components of the Ohio Graduation Tests given from 2006 to 2009, for example, no questions (out of about 140) referenced the Great Lakes, but an aquatic food chain and a question about biomagnifications involving aquatic organisms might be seen as referring to the lake ecosystem. Such questions may represent a springboard toward a larger presence of the Great Lakes in tests.

To work toward increasing Great Lakes subject matter in textbooks and tests, activities are under way to introduce the Great Lakes Literacy Principles to education leaders throughout the region and through the national COSEE network, as these key institutions and individuals represent the optimal delivery of information for current and future generations of learners. Outreach activities include public awareness efforts by Great Lakes Sea Grant extension agents, COSEE representation at research conferences, and presentations to state and federal agencies and nongovernmental organizations.

Research to Support the Public and Outreach to Support Research

Great Lakes Literacy Principles are also valuable for scientists. For principle 7, for instance, environmental observing systems are being designed to assist modeling of ecological and physical changes in the lakes. Scientists are forecasting impacts of invasive species on ecosystem stability and predicting climate change impacts for hazard preparation and damage mitigation. Researchers can use the principles as justification for education and outreach efforts that will enable them to achieve a broader impact. Validation by both scientists and educators makes the principles credible as guidance for how those groups can collaborate for increasing public understanding of Great Lakes science.

Great Lakes Literacy Principles will serve as guidance for research, education, informed decision making, and improved lifestyles for citizens in the region. The Great Lakes were dramatically degraded and challenged by human endeavors in recent times, but basic ecosystem processes have been restored through individual and collective efforts. Proper foresight and informed decision making, facilitated by endorsement of and attention to Great Lakes literacy, will continue to make the Great Lakes a model of environmental protection, restoration, and innovation.

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